SHWG Report for Task 1 – Harmonized Means of Compliance for 25.562

1 - What is underlying safety issue to be addressed by the FAR/JAR?

The intent of FAR/JAR 25.562 is to provide an appropriate level of safety for passengers occupying aircraft seats. The differences in FAA and JAA means of compliance to Section 25.562 led to the need for harmonizing activity.

2 - What are the current FAR and JAR standards relative to this subject?

Current FAR text: **Sec. 25.562 Emergency landing dynamic conditions.**

(a) The seat and restraint system in the airplane must be designed as prescribed in this section to protect each occupant during an emergency landing condition when—
  (1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and
  (2) The occupant is exposed to loads resulting from the conditions prescribed in this section.

(b) Each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy, as defined by 49 CFR Part 572, Subpart B, or its equivalent, sitting in the normal upright position.
  (1) A change in downward vertical velocity (Dv) of not less than 35 feet per second, with the airplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 14g.
  (2) A change in forward longitudinal velocity (Dv) of not less than 44 feet per second, with the airplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16g. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e., out of Parallel) with one rolled 10 degrees.

(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with paragraph (b) of this section:
  (1) Where upper torso straps are used for crewmembers, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.
  (2) The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1,500 pounds.
  (3) The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.
  (4) The lap safety belt must remain on the occupant's pelvis during the impact.
  (5) Each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1,000 units.
  The level of HIC is defined by the equation:

$$HIC = \left[(t_2 - t_1)\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a(t)\,dt\right]^{2.5}\right]_{max}$$

Where:

t1 is the initial integration time,
t2 is the final integration time, and
a(t) is the total acceleration vs. time curve for the head strike, and where (t) is in seconds, and (a) is in units of gravity (g).

(6) Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2,250 pounds in each femur.
(7) The seat must remain attached at all points of attachment, although the structure may have yielded.
(8) Seats must not yield under the tests specified in paragraphs (b)(1) and (b)(2) of this section to the extent they would impede rapid evacuation of the airplane occupants.

[Amdt. 25-64, 53 FR 17646, May 17, 1988]

Current JAR text: **JAR 25.562 Emergency landing dynamic conditions**
Date: May 27, 1994

(a) The seat and restraint system in the aeroplane must be designed as prescribed in this paragraph to protect each occupant during an emergency landing condition when—
(1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and
(2) The occupant is exposed to loads resulting from the conditions prescribed in this paragraph.

(b) Each seat type design approved for passenger occupancy must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound (77.11kg) anthropomorphic, test dummy sitting in the normal upright position:
(1) A change in downward vertical velocity, (v) of not less than 35 feet per second (10.67 m/s), with the aeroplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 14g.

(2) A change in forward longitudinal velocity (v) of not less than 44 feet per second (13.41 m/s), with the aeroplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16 g. Where floor rails or floor fittings are fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e. out of parallel) with one rolled 10 degrees.

(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with sub-paragraph (b) of this paragraph:
(1) Where upper torso straps are used tension loads in individual straps must not exceed 1750 pounds (793.78 kg). If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2000 pounds (907.18 kg).
(2) The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1500 pounds (680.38 kg).
(3) The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.
(4) The lap safety belt must remain on the occupant's pelvis during the impact.
Each occupant must be protected from serious head injury under the conditions prescribed in sub-paragraph (b) of this paragraph. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1000 units. The level of HIC is defined by the equation –

$$HIC = \left[(t_2 - t_1)\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a(t)\,dt\right]^{2.5}\right]_{MAX}$$

Where—
t(1) is the initial integration time,
t(2) is the final integration time, and
a(t) is the total acceleration vs. time curve for the head strike, and where (t) is in seconds, and (a) is in units of gravity (g).

(6) Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2250 pounds (1020.58 kg) in each femur.
(7) The seat must remain attached at all points of attachment, although the structure may have yield.
(8) Seals must not yield under the tests specified in sub-paragraphs (b)(1) and (b)(2) of this paragraph to the extent they would impede rapid evacuation of the aeroplane occupants.

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed?

FAR/JAR exist along with regulatory guidance material.

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in?:

The only difference between the FAR and JAR regulations is that the FAR is applicable to passenger and crew seats whereas the JAR is written against passenger seats only. This was not an issue for our group because we were tasked to work passenger seats and these are the seats for which there have been differing means of compliance to the regulations.

4 - What, if any, are the differences in the current means of compliance?

The FAA has accepted a "Revised Means of Compliance (RMOC)" which bases the test article selection process on a representative seat. The JAA method of compliance required a critical case selection for the test article.

5 – What is the proposed action?

Develop harmonized means of compliance based on a "family design" concept. This results in a simplified selection of a critical case seat(s) for certification. The process also allows for similarity comparisons to previously tested seats.

For each proposed change from the existing standard, answer the following questions:

6 - What should the harmonized standard be?

See attached concept paper for Task 1.

7 - How does this proposed standard address the underlying safety issue (identified under #1)?

Use of the principles in the concept paper result in an equivalent level of safety that is mutually acceptable by the FAA and JAA.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

The concept paper maintains the current level of safety. The regulation remains the same. The means of showing compliance has been standardized and clarified for all industry participants.

9 - Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

The concept paper maintains the current level of safety. The means of showing compliance has been standardized and clarified for all industry participants.

10 - What other options have been considered and why were they not selected?:

Two alternative methods of demonstrating compliance were considered as follows:

a) The Revised Means of Compliance (RMOC) – Because this method of compliance relied upon a "representative" seat to test instead of a "critical case" seat the team felt that this approach was not consistent with the "intent" of the rule. Some key concepts, such as the Family of Seats, had significant value and were incorporated into the concept paper.

b) Traditional Critical Case Analysis – This approach, while still acceptable, as a method of compliance, was not bounded in a practical way. This led to much iteration of analysis and an inconsistent expectation in the amount of detailed analysis required for a certification program. The concept paper focuses the seat assessment on the primary load path that is consistent with the Tradition Critical Case Analysis, but outlines a clearer expectation on the type and detail of analysis required.

11 - Who would be affected by the proposed change?

The seat suppliers, airframe manufacturers, regulatory authorities and airlines would have the choice of using the new ARAC concept paper approach or using the Tradition Critical Case Method.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble?

AC 25.562-1a

FAA Letters issued by the Transport Standards Staff

- *FAA Memorandum dated April 30, 1993, subject: "Yaw angle for the Down Test in Dynamic Seat Test, Section 25.562".*
- *FAA Memorandum dated May 11, 1994, subject: "Seat Strength Policy for Section 25.562".*
- *FAA Memorandum dated March 13, 1995, subject: "Additional Guidance Concerning Dynamic Testing of Transport Airplane Seats".*
- *FAA Memorandum dated January 18, 1996, subject: "Pass/Fail Criteria for Section 25.562, Dynamic Testing of Seats".*
- *FAA Memorandum dated February 16, 1996, subject: "Simplified Procedure for Addressing the Head Injury Criteria of Section 25.562". Reference: Policy Letter TAD-96-002.*
- *FAA Letter dated May 8, 1996, subject: "Public Meeting Response". Reference: 96-114-3.*

- *FAA Memorandum dated November 17, 1988, subject: "Seat Tracks Approved for use in Dynamic Tests under 25.562"*
- *FAA Memorandum dated October 20, 1997, subject: "Guidance for Demonstrating Compliance with Seat Dynamic Testing for Certain Derivative Airplanes". Reference: 97-112-38*
- *FAA Memorandum dated November 19, 1997, subject: "Guidance for Demonstrating Compliance with Seat Dynamic Testing Deceleration Pulse Shapes". Reference: 97-112-43*

Although not required, it would helpful to the industry to update TSO C127 to allow use of the ARAC concept paper as a method of test article selection.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted?

The content of ARAC-SHWG Task 1 Concept Paper should be adopted as FAA guidance material.

14 - How does the proposed standard compare to the current ICAO standard?

Unknown at this time

15 - Does the proposed standard affect other HWG's?

No

16 - What is the cost impact of complying with the proposed standard?

There is no anticipated increase in the cost of compliance using this new method. Preliminary data suggests that the industry may experience a cost reduction, but this has not been substantiated at this time.

17. - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

All data for this task is contained in the attached concept paper.

18.- Does the HWG wish to answer any supplementary questions specific to this project?

No supplementary questions have been identified at this time.

19. – Does the HWG want to review the draft NPRM at "Phase 4" prior to publication in the Federal Register?

Yes. The ARAC-SHWG wishes to review the draft guidance material before it is adopted by the regulatory agencies.

20. – In light of the information provided in this report, does the HWG consider that the "Fast Track" process is appropriate for this rulemaking project, or is the project too complex or controversial for the Fast Track Process? Explain.

The Fast Track process is appropriate for this task.

SEAT HARMONIZATION WORKING

Concept Paper Vote

NAME	AFFILIATION	Task 1	Task 2	Task 3
Jurgen Feldhaus	Daimler Chrysler Aerospace Airbus	Accept 2/3/00	Accept 2/3/00	Accept 2/3/00
Ronda Ruderman	Association of Flight Attendants	Accept 2/7/00	Accept 2/7/00	Accept 2/7/00
Vahe Bilezikjian	B/E Aerospace	Accept 2/2/00	Accept 2/2/00	Accept 2/2/00
Francis S. Heming, Jr (Frank)	B.F. Goodrich Aerospace - AMI Seating	Accept 2/2/00	Accept 2/2/00	Accept 2/2/00
Uwe Johannsen	Daimler Chrysler Aerospace Airbus	Accept 2/2/00	Accept 2/2/00	Accept 2/2/00
Jean-Paul Deneuville	JAA	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Jeff Gardlin	FAA	Accept 2/15/00*	Accept 2/4/00	Accept 2/4/00
Harald Merensky	Lufthansa	Accept 1/31/00	Accept 1/31/00	Accept 1/31/00
Thomas Amthor	Recaro Aircraft Seating	Accept 2/2/00	Accept 2/2/00	Accept 2/2/00
Nigel Smith	Rumbold	Accept 2/3/00	Accept 2/3/00	Accept 2/3/00
Nathan Wilson	Sicma Aero Seat	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Martine SAINTE-MARIE	Sogerma	Accept 2/3/00	Accept 2/3/00	Accept 2/3/00
Jeanne Elliott	Teamsters Airline Division	Accept 2/7/00	Accept 2/7/00	Accept 2/7/00
J. Hugh O'Conner	Transport Canada	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Tony Hobson	UK CAA	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Daniel Freeman	Boeing	Accept 1/26/00	Accept 1/26/00	Accept 1/26/00
Nick Calderone	Boeing	Accept 2/1/00	Accept 2/1/00	Accept 2/1/00
Steven J.Hooper	J. B. Dwerlikotte Assoc., Inc	Accept 2/8/00	Accept 2/8/00	Accept 2/8/00
Stephen Soltis	FAA (through Gardlin)	Accept 2/15/00*	Accept 1/19/00	Accept 1/19/00
Clive Bradbury	British Airways	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Laurent Pinsard	JAA-DGAC	Accept 1/31/00	Accept 1/19/00	Accept 1/19/00
Stefania Randisi	Registro Aeronautico Italiono (RAI-ENAC)	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00
Gregory R. Thiele	Weber Aircraft Inc.	Accept 2/1/00	Accept 2/1/00	Accept 2/1/00
Antonio Fiordelli	Avio Interiors	Accept 2/4/00	Accept 2/4/00	Accept 2/4/00

* Accepted if the mandatory comments that were provided were incorporated into the concept paper.